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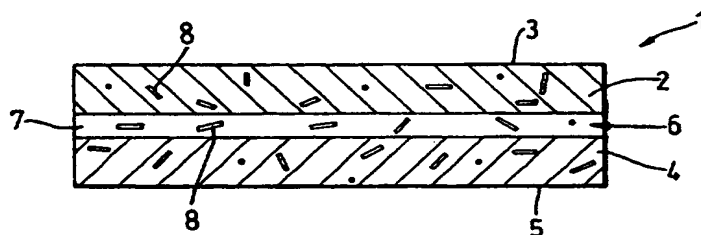
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EP 0908303 A2 EP 0224064 A2 US 5783504 A

(58) Field of Search  
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(54) Abstract Title  
Composite component

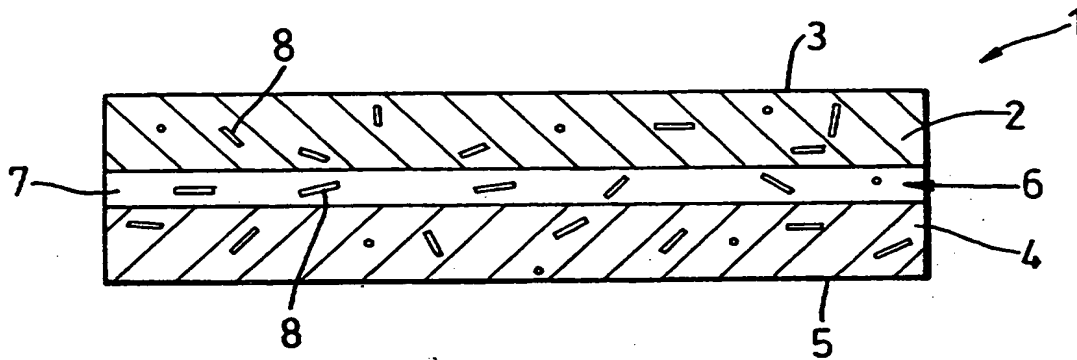
(57) A biodegradable composite 1 comprises a first layer 2 of biodegradable fibres, a second layer 4 of biodegradable fibres and a layer of biodegradable thermoplastic 6 disposed between the first and second layers of biodegradable fibres. The biodegradable thermoplastic permeates through each of the layers of biodegradable fibres. A method of manufacture of the composite is also disclosed (figure 2).



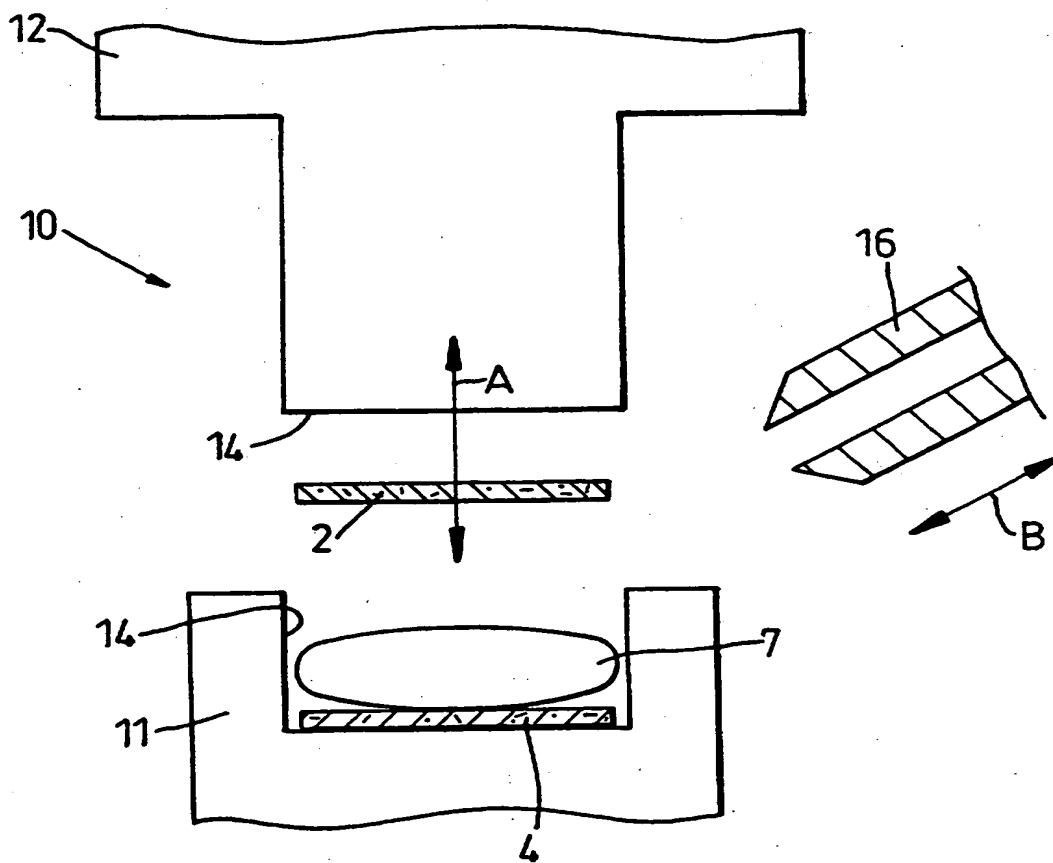
**Fig. 1**

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**Fig. 1**



**Fig 2**

Composite Component

The present invention relates to a biodegradable composite component and to a method of manufacture of such a composite component. Such a composite component has particular, but not exclusive, utility in the automotive field.

There are growing commercial pressures to develop products from renewable resources, such as agricultural crops, which are also biodegradable. Such products have the advantage that their disposal is less environmentally unfriendly than that of non-biodegradable products.

A number of biodegradable composites are known. It is known, for example from DE 4 440 246, to mix cellulosic reinforcing fibres with a biodegradable thermoplastic matrix to form a biodegradable composite. The mixture is typically heated and subsequently injected or extruded into an injection moulding machine to form a composite component.

It is also known, for example from US 5 719 203, to mix caoutchouc, starch, cellulose and a biodegradable agent to form a plasticised mass which may be heated in a twin screw extruder and subsequently injected into an injection moulding machine to form a composite component.

In both cases the composite component produced relies upon effective mixing of the matrix and filler constituents occurring prior to moulding of the composite component.

According to a first aspect of the present invention, a biodegradable composite comprises a first layer of biodegradable fibres, a second layer of biodegradable fibres and a layer of biodegradable thermoplastic disposed between the first and second layers of biodegradable fibres, the biodegradable thermoplastic permeating through each of the first and second layers of biodegradable fibres to a surface of the composite component.

Preferably, the biodegradable thermoplastic includes biodegradable filler material such as miscanthus fibres.

Preferably, either or both of the first and second layers of biodegradable fibres comprise one or more sheets of woven or non woven fibres. More preferably, the first and second  
5 layers contain equal numbers of sheets of woven or non woven fibres.

Preferably, the biodegradable fibres comprise hemp, jute, or the like.

According to a second aspect of the present invention, a method of producing a composite component according to the first aspect of the invention, comprises the steps of:

- providing a first part of a mould;
- 10 providing a second part of the mould, the first and second parts of the mould together defining a mould cavity having a surface;
- laying up a first layer of biodegradable fibres in the first part of the mould;
- introducing a quantity of the biodegradable thermoplastic to the first part of the mould over an uppermost surface of the first layer of biodegradable fibres;
- 15 laying up a second layer of biodegradable fibres over the biodegradable thermoplastic;
- bringing the first and second mould parts together to compress the fibres and the biodegradable thermoplastic together such that the biodegradable thermoplastic permeates through the first and second layers of biodegradable fibres to the surface of the mould cavity.

Preferably, the quantity of the biodegradable thermoplastic is introduced to the mould by  
20 an extrusion apparatus.

The invention will now be described, by way of example only, with reference to the accompanying Figures, in which:

Figure 1 shows a section through a composite material according to the present invention;

Figure 2 shows a diagrammatic side section of an apparatus suitable for use in the manufacture of the present invention.

Referring first to Figure 1 there is shown a section through a composite component 1 in accordance with the present invention. A first layer 2 of biodegradable fibres is disposed  
5 towards an upper surface 3 of the composite component. A second layer 4 of biodegradable fibres is disposed towards a lower surface 5 of the composite component.

The first and second layers 2,4 are typically of equal thickness. The first and second layers 2,4 typically comprise similar biodegradable fibres. For preference, the fibres comprise cellulosic fibres from an agricultural crop such as jute or hemp. Alternatively, the  
10 fibres may be formed from a biodegradable plastic, preferably a biodegradable thermoplastic.

A layer 6 of biodegradable thermoplastic 7 is disposed between the first and second layers 2,4 of biodegradable fibres. The biodegradable thermoplastic permeates through each of the first and second layers of biodegradable fibres to the surfaces of the composite component.

15 The biodegradable thermoplastic may include a cellulosic filler material 8. This may again be obtained from an agricultural crop. A suitable filler material is miscanthus fibres.

A method of manufacture of such a composite will now be described with reference to Figure 2.

A mould apparatus 10 is shown having a first mould part 11 and a second mould  
20 part 12. The first mould part 11 defines a first part of a mould cavity. The second mould part 12 defines a second part of the mould cavity. The mould cavity has an inner surface 14 defined by the parts of the mould cavity. The first and second mould parts may be displaced relativ to one another to open and close the mould cavity as indicated by arrow A.

An extruder 16 is provided to heat a biodegradable thermoplastic and subsequently extrude a quantity of the heated biodegradable thermoplastic. The extruder may be moveable as indicated by arrow B between a first position clear of the mould, and a second position in which it may extrude the heated biodegradable thermoplastic. Alternatively, an injector may  
5 be used for the same purpose.

While the first and second mould parts are separated from one another, a first layer 4 of biodegradable fibres is laid up in the first mould part. The first layer of fibres may comprise one or more separate sheets of woven or non woven fibres. For the purposes of clarity, the first layer in the illustrated embodiment of Figure 2 is shown comprising only a single sheet  
10 of fibres.

Once the first layer of fibres has been laid up, the extruder is moved from the first position to the second position. The extruder 16 then extrudes the quantity of biodegradable thermoplastic 7 onto an uppermost surface of the first layer 4 of fibres. The extruder is then returned to the first position. Before the thermoplastic 7 is allowed to cool, a second layer 2  
15 of fibres is laid up over the biodegradable thermoplastic. As with the first layer of fibres, the second layer may comprise one or more separate sheets of woven or non woven fibres. Again, for the purposes of clarity, the second layer in the illustrated embodiment of Figure 2 is shown comprising only a single sheet of fibres.

The first and second mould parts 11,12 are then brought together to close the mould  
20 cavity and to compress the layers 2,4 of fibres and the biodegradable thermoplastic 7 together. This has the effect of forcing the biodegradable thermoplastic to permeate through the first and second layers of biodegradable fibres to the surface 14 of the mould cavity to form a surface of the composite component so formed. The thermoplastic 7 is allowed to cool before the mould cavity is opened and the formed composite component removed from the  
25 mould. In this way, the surface finish of the formed composite component is determined by the finish of the surface of the mould cavity.

In the illustrated embodiment of the invention, the first and second layers of biodegradable fibres contain equal numbers of similar sheets of woven or non woven fibres of substantially equal thickness. This has been found not to produce undesirable stresses on the upper and lower surfaces of the formed composite component which may lead to undesired

5 twisting or curving of the formed composite component.

**CLAIMS**

1. A biodegradable composite component comprising a first layer of biodegradable fibres, a second layer of biodegradable fibres and a layer of biodegradable thermoplastic disposed between the first and second layers of biodegradable fibres, the biodegradable thermoplastic permeating through each of the first and second layers of biodegradable fibres to a surface of the composite.
2. A composite according to claim 1, characterised in that the biodegradable thermoplastic includes a biodegradable filler material such as miscanthus fibres.
3. A composite according to claim 1 or claim 2, characterised in that either or both of the first and second layers of biodegradable fibres comprise one or more sheets of woven or non woven fibres.
4. A composite according to claim 3, characterised in that the first and second layers contain equal numbers of sheets of woven or non woven fibres.
5. A composite according to any previous claim, characterised in that the biodegradable fibres comprise hemp, jute, or the like.
6. A composite according to any of claims 1 to 4, characterised in that the biodegradable fibres comprise a biodegradable plastic.
7. A biodegradable composite component substantially as described herein with reference to and as illustrated in Figure 1 of the accompanying drawings.



8. A method of producing a composite component according to any previous claim, comprises the steps of:  
providing a first part of a mould;  
providing a second part of the mould, the first and second parts of the mould together defining a mould cavity having a surface;  
laying up a first layer of biodegradable fibres in the first part of the mould;  
introducing a quantity of the biodegradable thermoplastic to the first part of the mould over an uppermost surface of the first layer of biodegradable fibres;  
laying up a second layer of biodegradable fibres over the biodegradable thermoplastic;  
bringing the first and second mould parts together to compress the fibres and the biodegradable thermoplastic together such that the biodegradable thermoplastic permeates the layers of biodegradable fibres to the surface of the mould cavity.
9. A method according to claim 8, characterised in that the quantity of the biodegradable thermoplastic is introduced to the mould by an extrusion apparatus.
10. A method of producing a composite component substantially as described herein with reference to and as illustrated in Figure 2 of the accompanying drawings.



Application No: GB 9910351.7  
Claims searched: 1-10

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**Patents Act 1977**  
**Search Report under Section 17**

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK CI (Ed.Q): B5A (AB11, AT1P, AT9P, AT11P)

Int CI (Ed.6): B29C 43/20 70/06

Other: Online: WPI, EPODOC, JAPIO

**Documents considered to be relevant:**

Category	Identity of document and relevant passage	Relevant to claims
A	EP 0908303 A2 (PRINCE)	
Y	EP 0224064 A2 (DORNIER) see especially figure 2 and related text	1,3-6,8
Y	US 5783504 (FIBERWEB) see whole document	1,3-6,8

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.